Chapter 3 outline

* Compound Light Microscope
* Earliest; most commonly used
* Scanning Electron Microscope
* 3-dimensional view
* Transmission Electron Microscope
* Greatest magnification
* Plasma membrane (Fig. 3-3)
* Encloses cell contents
* Main substance of membrane a double layer (bilayer) containing:
  + - Phospholipids (lipid molecules containing phosphorus)
    - Cholesterol —between phospholipids
    - Proteins — do much of the “work” in a cell
      * Channels
      * Transporters
      * Receptors
      * Enzymes
      * Linkers
      * Cell identity markers
* Role of plasma membrane in cell functions
  + - Growth
    - Reproduction
    - Cell interaction

Regulates what enters/leaves the cell; semipermeable barrier

* Organelles
* Nucleus — largest organelle, “control center” of cell
  + - Chromosomes
      * Units of heredity
      * Differing appearance during cell cycle
    - Nucleolus
      * Ribosome assembly
* Cytoplasm (Table 3-1) — holds the remaining organelles
  + - Endoplasmic reticulum (ER)
      * Smooth ER — synthesis of lipids
      * Rough ER — ribosomes give texture, necessary for protein manufacture
    - Mitochondria
      * Energy from nutrients converted to energy for cell, ATP
    - Golgi apparatus
      * Protein sorting and modification
    - Lysosomes — contain digestive enzymes, remove waste from cell
    - Peroxisomes  
      (Box 3-1) — enzymes destroy substances produced by metabolism
    - Vesicles — storage
    - Centrioles — function in cell division
* Surface organelles
  + - Cilia — move fluids around cell
    - Flagellum — sperm cell only, for propulsion
* Cellular diversity (Fig. 3-4)
  + - Individual cells may vary widely in size, shape, composition
    - Cell shape related to cell function
    - Number of organelles vary depending on function
* DNA and RNA
* Both nucleic acids
  + - Deoxyribonucleic acid (DNA)
    - Ribonucleic acid (RNA)
* Both have four nucleotides; three in common
* DNA — master blueprint for a cell
* Mostly within nucleus; protected by the nuclear membrane
* Double strand within chromosome
* DNA contains genes
  + - Distinct region of chromosome
    - Hereditary units that control all cell activities;
* Divided into subunits, nucleotides, which carry codes for manufacture of proteins
* Nucleotides
  + - Adenine (A)
    - Guanine (G)
    - Cytosine (C)
    - Thymine (T)
* Specific nucleotide pairs
  + - According to nitrogen bases
    - Always A with T, G with C
* RNA
* Interprets the DNA “blueprint”
* Single strand of nucleotides
  + - Same as DNA, but uracil (U) instead of thymine (T)
* mRNA
* Messenger RNA
* Built on DNA strand in nucleus, transcribes nucleotide code
* Moves to cytoplasm and attaches to a ribosome
* rRNA
* Ribosomal RNA
* With protein makes up ribosomes, the sites of protein synthesis in cytoplasm
* Involved in process of translating genetic message into a protein
* tRNA
* Transfer RNA
* Works with other forms of RNA to translate genetic code into protein

Each molecule of tRNA carries a particular amino acid that can be used to build a protein at the ribosome

* Protein Synthesis
* Transcription (Fig. 3-7)
  + - RNA template created from DNA blueprint
* Translation (Fig. 3-8)
  + - Assembly of amino acids into a protein, based on the sequence of the mRNA
* Mitosis — cell division of somatic cells (egg and sperm cells divide by meiosis)
* DNA replication must precede mitosis
* Interphase — stage between one mitosis and the next; lasts longer than mitosis
* Stages of mitosis (Fig. 3-9)
  + - Prophase
      * Double strands of DNA return to their tightly wound spiral organization
      * Nucleolus and nuclear membrane begin to disappear
      * In cytoplasm, the two centrioles move toward opposite ends of cell, a spindle-shaped structure made of thin fibers begins to form between them
    - Metaphase
      * Chromosomes line up across the center of the cell attached to spindle fibers
    - Anaphase
      * The centromere splits, duplicated chromosomes separate, begin to move toward opposite ends of the cell
    - Telophase
      * A membrane appears around each group of separated chromosomes, forming two new nuclei
      * Cell splits in two
    - Back to interphase with two new cells
* Differences in the process among body cells
  + - Some multiply rapidly
    - Some eventually stop dividing, stay in interphase
* Movement of substances across the plasma membrane (semipermeable membrane) (Table 3-5) grouped by:
* Energy requirements
* Physical requirements
* Molecular size
* Solubility
* Electrical charge
* High-to-low concentration
* Passive vs. active transport
* Movement that does not require cellular energy
* Diffusion (Fig. 3-10, 3-11) — random movement from higher concentration to lower concentration until reach equilibrium
* Osmosis (Fig. 3-12, 3-13) — diffusion of water through semipermeable membrane
* Filtration (Fig. 3-14) — movement
* Facilitated diffusion (Fig. 3-15)
* Movement that requires cellular energy
* Active transport: against natural flow
  + - Proteins in cell membrane act as transporters for particles
    - Membrane limits which particles can pass through — selectively permeable
* Bulk transport (vesicular transport)
  + - Endocytosis
      * Phagocytosis (Fig. 3-16) — relatively large particles engulfed by plasma membrane, moved into cell to be destroyed
      * Pinocytosis — “cell drinking,” intake of fluid
    - Exocytosis (Fig. 3-17) — cell moves materials out in vesicles
* Osmosis and cells (Fig. 3-18) — normal fluid balance when fluid outside cells has same concentration of solutes as fluid inside cells
* Fluid balance and solutes: high to low concentration  
  (Table 3-6)
  + - Isotonic — solutions with concentrations equal to that of cytoplasm, e.g., blood plasma
    - Hypotonic —less concentrated than intracellular fluid
      * Hemolysis — red blood cell in hypotonic solution: will swell, may burst
    - Hypertonic — more concentrated than intracellular fluid
      * Crenation — cell in hypertonic solution: will lose water and shrink
* Cell aging — with time, cells can be damaged or die
* Free radicals injure
* Harmful enzymes from deteriorating lysosomes
* Gene mutation
  + - Natural occurrence in cell division
    - Increased by exposure to harmful substances and radiation
    - Can lead to cancer
* Age of person
* Apoptosis — programmed cell death; normal
* Word parts related to cells, their structure and function, and cancer
* The role of cells: *cytology*
  + - cyst*/o* (cell)
* Microscopes: *microscopes*
  + - micr/o (small)
* Cell structure: *bilayer; ribosomes; chromosomes; endoplasmic; lysosomes*
  + - bi- (two)
    - –some (body)
    - chrom/o- (color)
    - end/o- (in, within)
    - lys/o- (loosening, dissolving, separating)
* Cell functions: *interphase, prophase, metaphase, anaphase, telophase, semipermeable, phagocytosis, exocytosis, isotonic, hypotonic, hemolysis, hypertonic*
  + - inter- (between)
    - pro- (before, in front of)
    - meta- (change)
    - ana- (upward, back, again)
    - tel/o- (end)
    - semi- (partial, half)
    - phag/o- (to eat, ingest)
    - pino (to drink)
    - ex/o- (outside, out of, away from)
    - iso- (same, equal)
    - hypo- (deficient, below, beneath)
    - hem/o- (blood)
    - hyper- (above, over, excessive)